

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
21 June 2007 (21.06.2007)

PCT

(10) International Publication Number
WO 2007/068061 A1

(51) International Patent Classification:

G01K 11/00 (2006.01) G01K 11/06 (2006.01)
G01K 5/00 (2006.01) G01K 11/12 (2006.01)
G01K 5/10 (2006.01)

(21) International Application Number:

PCT/AU2006/001912

(22) International Filing Date:

15 December 2006 (15.12.2006)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

2005907080 16 December 2005 (16.12.2005) AU

(71) Applicant (for all designated States except US): **SAFETY MEDICAL PRODUCTS LIMITED** [AU/AU]; 2 Nina Court, Salisbury Heights, S.A. 5109 (AU).

(72) Inventor; and

(75) Inventor/Applicant (for US only): **RIEMELMOSER, John** [AU/AU]; 2 Nina Court, Salisbury Heights, S.A. 5109 (AU).

(74) Agent: **MADDERN**; Level 1, 64 Hindmarsh Square, Adelaide, S.A. 5000 (AU).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

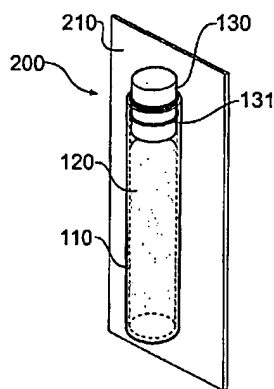
(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: **FREEZE INDICATING DEVICE**



(57) Abstract: A freeze indicating device is disclosed. The device indicates that it has been subjected to a freezing temperature and includes a vessel having an open end, the vessel containing an amount of a liquid that expands at or near the freezing temperature and sealing means for sealing the open end of the vessel, wherein the sealing means interacts with the liquid upon freezing of the liquid and undergoes displacement with respect to the vessel to indicate that the liquid has frozen.

WO 2007/068061 A1

FREEZE INDICATING DEVICE

FIELD OF THE INVENTION

The present invention relates to a temperature indicating device. In a particular form, the present invention relates to a freeze indicating device for providing a visible record that the environment local to the device has been subject to a freezing temperature.

BACKGROUND OF THE INVENTION

Whilst in many applications, such as in the transport and preparation of foodstuffs, it is important that related temperatures do not exceed a maximum temperature for a predetermined amount of time often, it is important to ensure that items being kept in a cool environment do not in fact freeze.

One such example is the storage of vaccines. These must be kept cool, often within a narrow range of temperatures that approach 0° C. However, a vaccine will spoil if it freezes, thereby rendering it useless. Accordingly, cooled storage containers which are used to store vaccines must be able to regulate cooling temperatures to a high degree. A vaccine which has been frozen and has not thawed will be plainly evident on removal from the fridge or cooled storage container. However, where a vaccine may have frozen and then subsequently thawed due to irregularities in the cooling mechanism of the cooled storage container then there will be no evidence of this having occurred. This will then potentially result in a spoiled vaccine being administered. There have been a number of freeze indicators that have been developed that have attempted to address this issue.

US Patent No. 4,132,186 describes a freeze indicating device comprising a constant total volume container having a first chamber, where the first

chamber includes a reservoir portion and an elongated portion with a passage communicating at one end with said reservoir portion and at the other end of said device with an indicating material; a second chamber having an expandable wall, said second chamber located within the reservoir of said first chamber; an aqueous first liquid in said second chamber; a second liquid substantially filling said reservoir portion of the first chamber and having a fluid character at the freezing point of said aqueous liquid; a visible indicating material for said second liquid at the vented end of said passage; and the length of said passage and the position of said indicating material being such that upon the freezing and expansion of said aqueous liquid, the second liquid in said reservoir is forced through said passage and into contact with said visible indicating material. Clearly, this device has the disadvantage of incorporating two separate liquids and a number of chambers, one of these chambers including an expandable wall. This makes the device overly complicated to manufacture.

US Patent No. 4,145,918 describes a device for indicating that an environment has reached or passed through the temperature near a freezing point of a liquid comprising: a frangible sealed ampule, a liquid being enclosed in said ampule, said liquid having the characteristic of expanding in volume at or near its freezing point, said ampule having at least a first and a second face, said first face having an indentation projecting relatively close to but spaced from said second face inside of said ampule, said indentation forming a sharp acute angle inside of said ampule, said indentation performing the dual function of providing a site for encouraging crystal growth when said liquid is at or near its freezing point and further providing a mechanism for strengthening said first face of said ampule relative to said second face whereby said frangible, sealed ampule will consistently break upon the expansion of said liquid, thereby indicating that the environment has reached

or passed through a temperature near the freezing point of said liquid. Again, the complicated internal structure of the ampule makes this device difficult to fabricate making the unit cost of each device high.

- 5 US Patent No. 4,191,125 describes a freeze indicator comprising a frangible container, said container housing a liquid which expands upon freezing, thereby fracturing said container, said liquid having a nucleating agent disbursed therein, said nucleating agent being substantially insoluble in said liquid, liquid responsive indicator means, said nucleating agent and said
- 10 liquid having substantially similar molecular space groupings whereby undercooling of said liquid is substantially prevented; said container further housing a surfactant which is mixed with said liquid and said nucleating agent before freezing of said liquid for providing increased contact between said nucleating agent and said liquid and further providing a decrease in
- 15 surface tension between said container, when fractured, and said liquid whereby a substantial immediate indication of freezing is provided on said liquid responsive indicating means. Clearly, the use of a number of different chemical materials such as surfactants and a nucleating agent adds to the complexity of this freeze indicator again making the associated costs of
- 20 manufacture relatively high.

It is an object of the present invention to provide a freeze indicating device that is capable of being manufactured in a simple and cost effective manner.

- 25 It is an object of the present invention to provide a freeze indicating device that is capable of providing a clear indication that the device has frozen.

It is a further object of the present invention to provide a freeze indicating device which is capable of being readily integrated with a temperature

indicating device to indicate that the device has been exposed to temperatures outside of a predetermined temperature range.

SUMMARY OF THE INVENTION

5 In a first aspect the present invention accordingly provides a freeze indicating device for indicating that the device has been subjected to a freezing temperature, the device including:

a vessel having an open end, the vessel containing an amount of a liquid that expands at or near the freezing temperature; and

10 sealing means for sealing the open end of the vessel, wherein the sealing means interacts with the liquid upon freezing of the liquid and undergoes displacement with respect to the vessel to indicate that the liquid has frozen.

Preferably, displacement of the sealing means exposes an indicating region to
15 indicate that the liquid has frozen.

Preferably, the indicating region is located on the sealing means.

Optionally, the indicating region is located on an external surface of the
20 vessel.

Preferably, the amount of the liquid causes the sealing means to be separated from the vessel upon freezing of the liquid.

25 Preferably, the device further includes liquid indicator means to interact with the liquid on thawing.

Preferably, the liquid indicator means includes an absorbent member incorporating a liquid soluble indicator which dissipates into the absorbent member on contact with the liquid on thawing.

- 5 Optionally, the vessel is open at both ends and includes corresponding sealing means located at each end which undergo displacement on freezing of the liquid.

10 In a second aspect the present invention accordingly provides a temperature range indicating device for indicating that the device has been subjected to a temperature outside of a predetermined temperature range, the predetermined temperature ranged defined at a lower end by a freezing temperature and at an upper end by a raised temperature, the device including:

- 15 a vessel having a first chamber wherein the first chamber includes an amount of a liquid that expands at or near the freezing temperature and sealing means for sealing an open end of the chamber, wherein the sealing means interacts with the liquid upon freezing of the liquid and undergoes displacement with respect to the vessel to indicate that the liquid has frozen;
20 and

 raised temperature indicating means to provide a visual indication when the vessel has been subjected to the raised temperature.

25 Preferably, the raised temperature indicating means includes a second chamber for the vessel, the second chamber including:

 a reservoir of indicating material being solid below the raised temperature and liquid at or above the raised temperature; and

a wicking member arranged in contact with the reservoir so that the indicating material migrates from the reservoir when in liquid form to the wicking member to provide the visual indication of the raised temperature.

- 5 Optionally, the sealing means is adapted to melt at the raised temperature, thereby providing the visual indication of the raised temperature.

BRIEF DESCRIPTION OF THE DRAWINGS

- Embodiments of the present invention will be discussed with reference to the
- 10 accompanying drawings wherein:
- FIGURES 1a and 1b are front perspective and sectional views of a freeze indicating device according to a first embodiment of the present invention;
- FIGURES 2a and 2b are front perspective and sectional views of the freeze indicating device illustrated in Figures 1a and 1b after freezing;
- 15 FIGURES 3a and 3b are front perspective and sectional views of a freeze indicating device according to a second embodiment of the present invention;
- FIGURES 4a and 4b are front perspective and sectional views of the freeze indicating device illustrated in Figures 3a and 3b after freezing;
- FIGURES 5a and 5b are front perspective and sectional views of the freeze
- 20 indicating device illustrated in Figures 4a and 4b after subsequent thawing;
- FIGURES 6a and 6b are front perspective and sectional views of a freeze indicating device according to a third embodiment of the present invention;
- FIGURES 7a and 7b are front perspective and sectional views of the freeze indicating device illustrated in Figures 6a and 6b after freezing;
- 25 FIGURE 8 is a front sectional view of a temperature range indicating device according to a further embodiment of the present invention;
- FIGURE 9 is a front sectional view of the temperature range indicating device illustrated in Figure 8 after freezing; and

FIGURE 10 is a front sectional view of the temperature range indicating device illustrated in Figure 8 after being exposed to a predetermined raised temperature.

- 5 In the following description, like reference characters designate like or corresponding parts throughout the several views of the drawings.

DESCRIPTION OF EMBODIMENTS

- Referring now to Figures 1a and 1b, there is shown a freeze indicating device
- 10 100 according to a first embodiment of the present invention. Freeze indicating device 100 includes a vessel 110 open at one end and filled to approximately 95% capacity with an aqueous substance 120. Whilst in this embodiment, vessel 110 is a clear tube formed from a suitable rigid plastic or alternatively glass, it would be apparent to those skilled in the art that vessel
- 15 110 need not be tubular but may have any other regular or non-regular sectional or tapered shape as required.

- Additionally, whilst the aqueous substance 120 that has been employed in this embodiment is water, clearly any other liquid substance which expands
- 20 on freezing is contemplated to be within the scope of the invention. Additionally compositions or admixtures of liquid substances and other materials such as nucleating agents are also considered to be within the scope of the invention. As would be appreciated by those skilled in the art, the temperature at which the liquid substance freezes may be modified to some
- 25 extent by changing its composition.

Inserted into the open end of vessel 110 is a stopper or plug 130 which functions as a sealing means and is formed of a resilient material such as injection moulded polypropylene or other suitably resilient compound. Plug

130 includes a number of circumferential ridges 131 which aid in forming a seal between the inner wall of vessel 110 and plug 130. Plug 130 is inserted into vessel 110 a distance less than the amount that the aqueous substance would be expected to traverse on expansion due to freezing. The sealing force
5 between plug 130 and vessel 110 is adapted to be less than that of the expansion force of aqueous substance 120 as it freezes. This results in plug 130 being displaced with respect to or relative to vessel 110.

Referring now to Figures 2a and 2b, as aqueous substance 120 freezes it
10 gradually forces plug 130 from vessel 110, eventually causing it to be displaced completely resulting in plug 130 being separated from vessel 110, thereby providing a clear visual indication that freeze indicating device 100 has been subjected to a temperature sufficient to cause such freezing to occur. Whilst in this embodiment vessel 110 is transparent, clearly vessel 110 may be
15 opaque and plug 130 be of a suitable contrasting colour to vessel 110 to provide an indicating region as required. In another alternative embodiment (not shown), vessel 110 may be open at both ends with corresponding plugs 130 which each undergo displacement with respect to vessel 110 as aqueous substance 120 freezes.

20 If temperature indicating device 100 thaws, aqueous substance 120 will simply melt and leave vessel 110. Where an object is spoiled due to this freezing, the presence of the aqueous substance 120 in liquid form is not an issue. However, if there is a requirement to prevent any liquid from freeze
25 indicating device 100 from further interacting with the object whose temperature is being monitored, then indicating device may be enclosed in a further blister package or other suitable packaging sufficient to allow plug 130 to be displaced from vessel 110 as aqueous substance 120 freezes.

- If the plug 130 is not fully ejected from vessel 110 and if the aqueous substance 120 further re-thaws, then plug 130 may be drawn back or retract partially into vessel 110 due to the vacuum force provided by the sealed vessel. Whilst a visual indication will still be provided by the overall displacement of the plug, in a further embodiment the plug 130 and/or end of the vessel are modified so as to break the seal as plug 130 is initially displaced by the freezing of aqueous substance 120. This may be achieved in one embodiment by tapering plug 130.
- 10 Referring now to Figures 3a and 3b, there is shown a freeze indicating device 200 according to a second embodiment of the present invention. In this embodiment, a freeze indicating device 100 of the first embodiment is attached to a portion of indicator paper 210 which functions as a liquid indicator means and incorporates a layer of water soluble ink or other water soluble indicator. Once again, as shown in Figures 4a and 4b, as freezing of freeze indicating device 200 occurs, plug 130 will be separated from vessel 110 in the process providing a clear indication that the local environment to the indicating device has reached a sufficiently low temperature.
- 20 As aqueous substance 120 begins to thaw, it will gradually be absorbed by indicator paper 210 or more generally absorbent member, in the process causing water soluble ink 220 to dissipate in indicator paper 210 (as best seen in Figures 5a and 5b), thereby providing further indication that temperature indicating device 200 has frozen and subsequently thawed. Once again, freeze indicating device 200 may be suitably packaged to isolate it from the immediate environment as required.

Referring now to Figures 6a and 6b, there is shown a freeze indicating device 300 according to a third embodiment of the present invention. Indicating

device 300 includes a vessel 310 open at one end containing an aqueous substance 320 and a cover or cap member 330 which sealingly engages with the open end of vessel 310 to prevent the escape of aqueous substance 320.

Cap member 330 may include internal ridges or other sealing means to

5 improve the seal. In this embodiment, cap member 330 and the exposed surface 316 of vessel 310 are opaque. The amount of aqueous substance 320 is fixed to cause cap member 330 to be displaced but to not be completely separated from vessel 310 due to the expansion forces resulting from the freezing of aqueous substance 320.

10

Referring now to Figures 7a and 7b, there is shown freeze indicating device 300 after being subjected to suitably cold temperatures to cause freezing of aqueous substance 320. As cap member 330 is displaced with respect to vessel 310, indicating region 315 which is located on the exposed surface 316 of

15 vessel 310 is exposed, thereby providing a clear visual indication that the aqueous substance 320 has frozen. As would be apparent to those skilled in the art, freeze indicating device 300 would also be suitable for those applications where it is important that aqueous substance 320 be fully enclosed and not allowed to escape from vessel 310.

20

Referring now to Figures 8, 9 and 10, there is shown a temperature range indicating device 400 according to a further embodiment of the present invention. Temperature range indicating device 400 includes a tubular member 410 open at both ends and incorporating a central partition or wall

25 460 dividing tubular member into a first chamber 411 and second chamber 412. First chamber 411 contains aqueous substance 420 and cap member 430 and is filled to a predetermined level whereby on freezing of aqueous substance 420, cap member 430 is displaced revealing indicator portion 415

(as best shown in Figure 9). Otherwise the outside surface of first chamber 411 is generally opaque.

- Second chamber 412 includes a reservoir 440 of indicating material which in this embodiment is blotting paper impregnated with a coloured organic compound such as a fatty acid or an alcohol or their derivatives. As an alternative to blotting paper, any form of sponge or woven or non-woven fibrous material may also be employed as a reservoir.
- 10 In contact with reservoir 440 is a wicking member 450 which is a thin sheet of blotting paper. Alternatively, any form of woven or non-woven sheet material having the required wicking properties would be suitable. In another embodiment, reservoir 440 is incorporated into wicking member 450. The surface of second chamber 412 in this embodiment is transparent allowing full
- 15 view of reservoir 440 and wicking member 450 but alternatively the outside surface may be partially opaque and include a viewing aperture with indicator markings to view the wicking member 450. Providing a seal against dust and the like, second chamber 412 also includes a cap member 470.
- 20 As best seen in Figure 10, once indicating device 400 becomes exposed to a predetermined raised temperature, the indicator material located in reservoir 440 will migrate from reservoir 440 into wicking member 450 providing a visual indication 445 of the raised temperature environment and functioning as a raised temperature indicating means. A barrier member (not shown) may
- 25 be incorporated into wicking member 450 so that there is only a visual indication once the indicator material has migrated past barrier member, thereby indicating that a predetermined raised temperature history has occurred.

Thus temperature indicating device 400 provides an indicator that the temperature of a given environment or an object to which the indicating device has been attached has stayed within a certain range defined at a lower end by the temperature at which aqueous substance 420 freezes (as best seen
5 in Figure 9) and at an upper end by the temperature at which indicating material in reservoir 440 migrates into wicking member 450 (as best seen in Figure 10).

In another embodiment of a temperature range indicating device according to
10 the present invention, the cap member or plug may be formed of a material that has a melting point corresponding to the upper end of temperature range indicating device, thereby also functioning as a raised temperature indicating means. In this manner, the combination of the aqueous substance escaping the vessel and the destruction of the cap member or plug will indicate that the
15 device has been exposed to raised temperatures. At the lower temperature end, displacement of the cap member or plug will indicate that the aqueous substance has frozen.

A brief consideration of the above described embodiments will indicate that
20 the invention provides an extremely simple and economical freeze indicating device which is effective to significantly reduce the manufacturing costs associated with such devices.

Although a number of embodiments of the present invention have been
25 described in the foregoing detailed description, it will be understood that the invention is not limited to the embodiment disclosed, but is capable of numerous rearrangements, modifications and substitutions without departing from the scope of the invention as set forth and defined by the following claims.

THE CLAIMS:

1. A freeze indicating device for indicating that the device has been subjected to a freezing temperature, the device including:
 - a vessel having an open end, the vessel containing an amount of a
 - 5 liquid that expands at or near the freezing temperature; and
 - sealing means for sealing the open end of the vessel, wherein the sealing means interacts with the liquid upon freezing of the liquid and undergoes displacement with respect to the vessel to indicate that the liquid has frozen.
- 10 2. The freeze indicating device as claimed in claim 1, wherein displacement of the sealing means exposes an indicating region to indicate that the liquid has frozen.
3. The freeze indicating device as claimed in claim 2, wherein the indicating region is located on the sealing means.
- 15 4. The freeze indicating device as claimed in claim 2, wherein the indicating region is located on an external surface of the vessel.
5. The freeze indicating device as claimed in any one of the preceding claims, wherein the amount of the liquid causes the sealing means to be separated from the vessel upon freezing of the liquid.
- 20 6. The freeze indicating device as claimed in claim 5, wherein the device further includes liquid indicator means to interact with the liquid on thawing.
7. The freeze indicating device as claimed in claim 6, wherein the liquid indicator means includes an absorbent member incorporating a liquid soluble

indicator which dissipates into the absorbent member on contact with the liquid on thawing.

8. The freeze indicating device as claimed in any one of the preceding claims, wherein the vessel is substantially tubular.

5 9. The freeze indicating device as claimed in claim 8, wherein the vessel is open at both ends and includes corresponding sealing means located at each end which undergo displacement on freezing of the liquid.

10 10. The freeze indicating device as claimed in any one of the preceding claims, wherein the sealing means includes a plug or stopper inserted into the open end.

11. The freeze indicating device as claimed in claim 10, wherein the stopper includes circumferential ridges to improve sealing with the vessel.

12. The freeze indicating device as claimed in any one of claims 1 to 10, wherein the sealing means includes a cap member, the cap member to cover
15 the open end of the vessel.

13. A temperature range indicating device for indicating that the device has been subjected to a temperature outside of a predetermined temperature range, the predetermined temperature ranged defined at a lower end by a freezing temperature and at an upper end by a raised temperature, the device
20 including:

a vessel having a first chamber wherein the first chamber includes an amount of a liquid that expands at or near the freezing temperature and sealing means for sealing an open end of the chamber, wherein the sealing means interacts with the liquid upon freezing of the liquid and undergoes

displacement with respect to the vessel to indicate that the liquid has frozen;
and

raised temperature indicating means to provide a visual indication
when the vessel has been subjected to the raised temperature.

5

14. The temperature range indicating device of claim 13, wherein the
raised temperature indicating means includes a second chamber for the
vessel, the second chamber including:

a reservoir of indicating material being solid below the raised
10 temperature and liquid at or above the raised temperature; and

a wicking member arranged in contact with the reservoir so that the
indicating material migrates from the reservoir when in liquid form to the
wicking member to provide the visual indication of the raised temperature.

15. The temperature range indicating device of claim 14, wherein the
15 raised temperature indicating means includes a barrier member, the barrier
member substantially overlaying and in contact with the wicking member,
wherein the barrier member allows for viewing of the visual indication when
the indicating material has migrated past the barrier member.

16. The temperature range indicating device of claim 14 or 15, wherein an
20 external surface of the second chamber of the vessel is partially opaque and
includes a viewing aperture to view the wicking member.

17. The temperature indicating device of claim 13, wherein the sealing
means is adapted to melt at the raised temperature, thereby providing the
visual indication of the raised temperature.

1/4

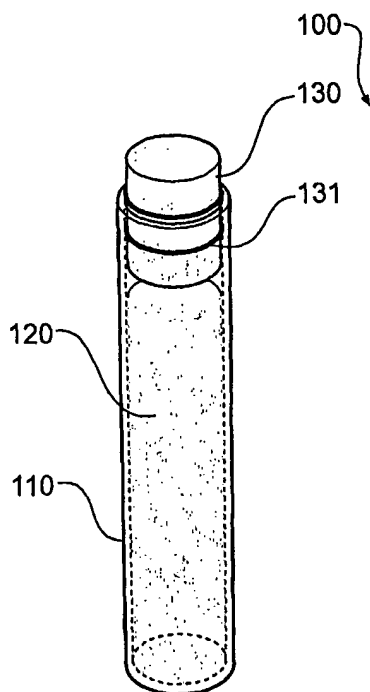


Figure 1a

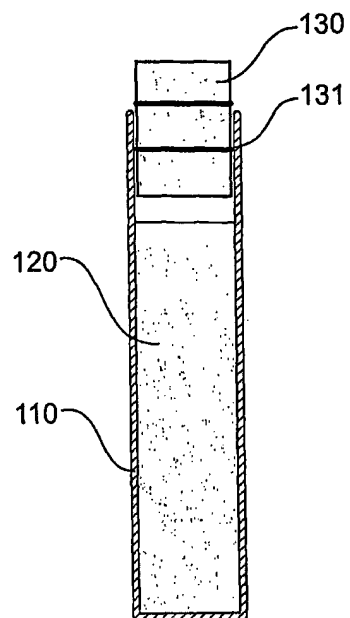


Figure 1b

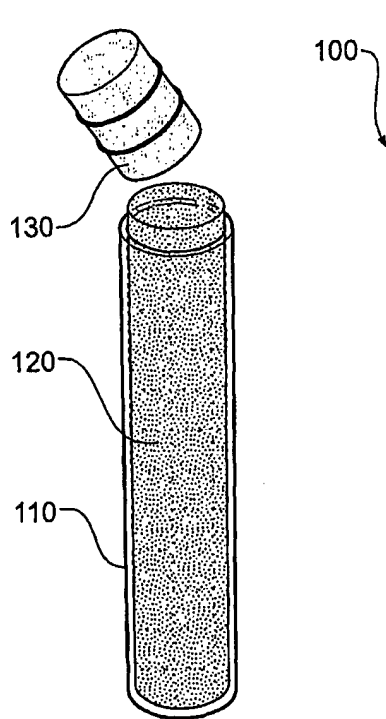


Figure 2a

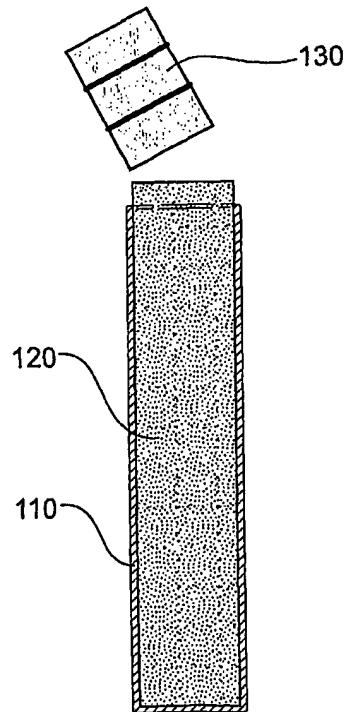


Figure 2b

2/4

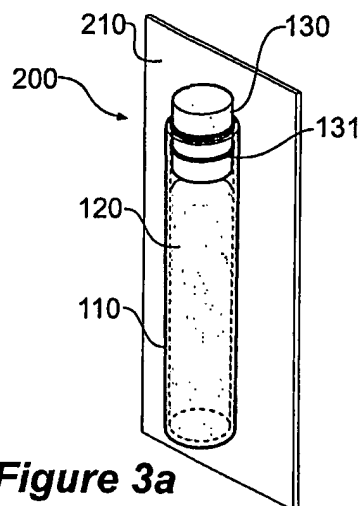


Figure 3a

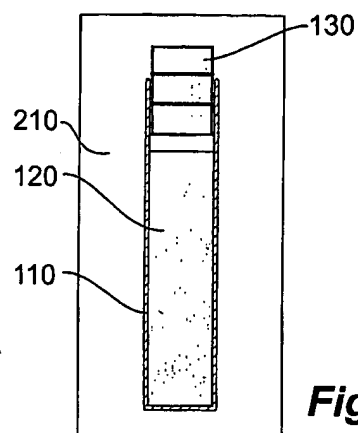


Figure 3b

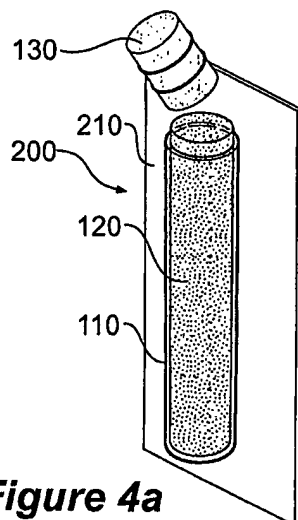


Figure 4a

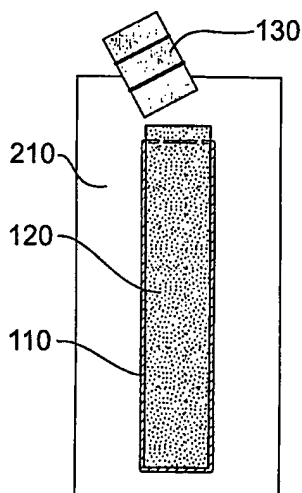


Figure 4b

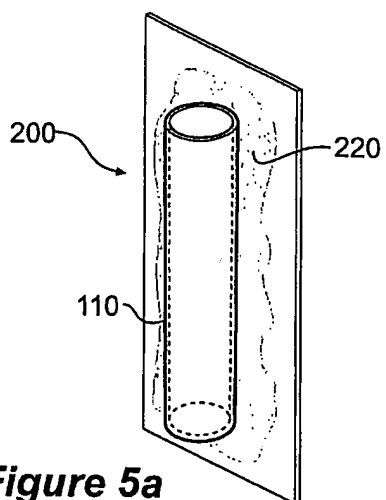


Figure 5a

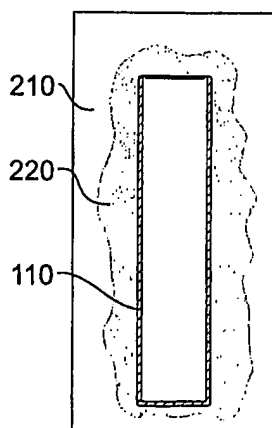


Figure 5b

3/4

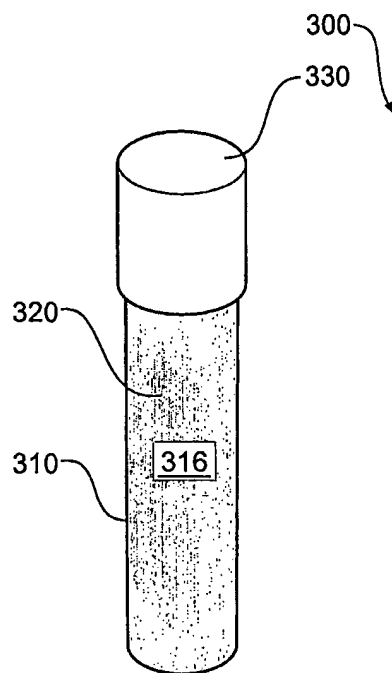


Figure 6a

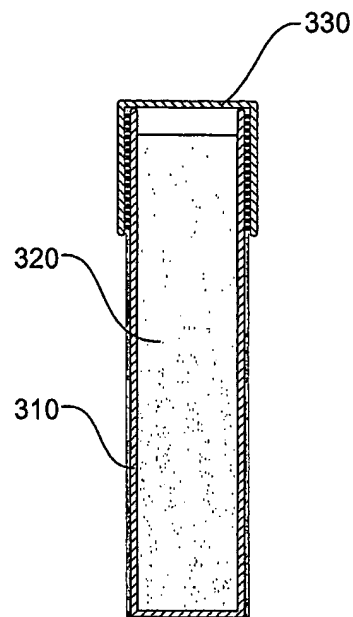


Figure 6b

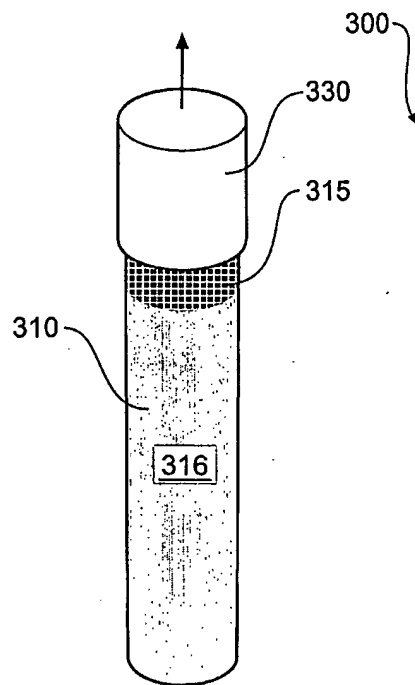


Figure 7a

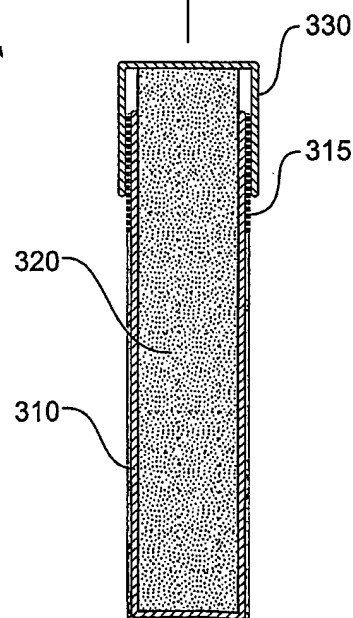


Figure 7b

4/4

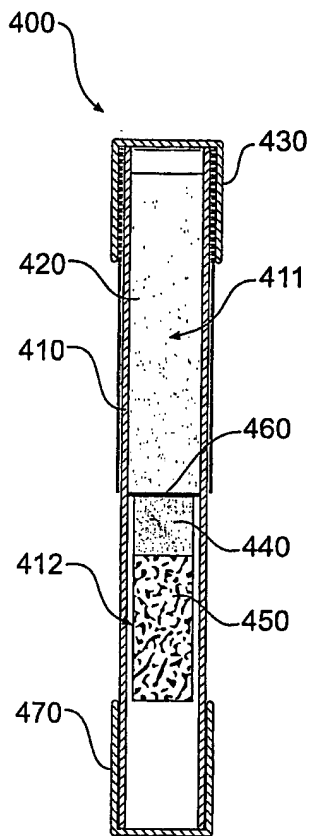


Figure 8

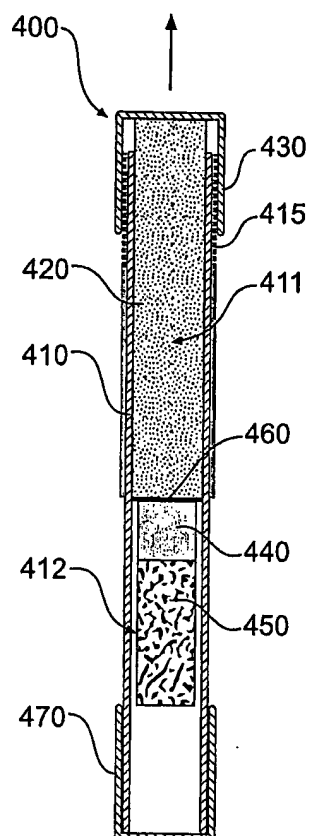


Figure 9

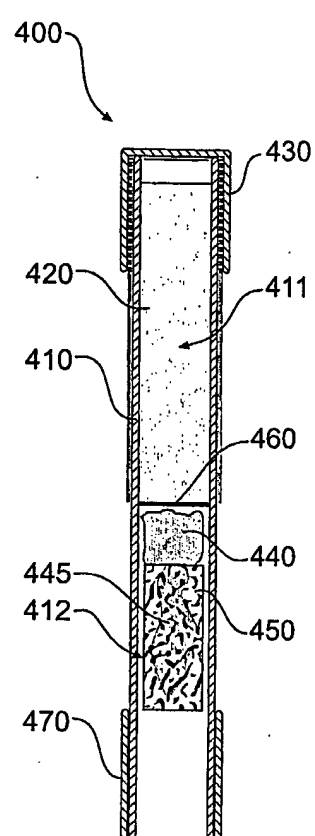


Figure 10

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU2006/001912

A. CLASSIFICATION OF SUBJECT MATTER		
Int. Cl.		
<i>G01K 11/00</i> (2006.01) <i>G01K 5/10</i> (2006.01) <i>G01K 11/12</i> (2006.01) <i>G01K 5/00</i> (2006.01) <i>G01K 11/06</i> (2006.01)		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) see below under "Electronic databases searched"		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) DWPI: and keywords like FREEZ+, FROZE+, INDICAT+, SHOW+, DISPLA+, VISUAL+, VISIBLE+, EXHIBIT+, SIGHT+, VESSEL?, TUBE?, TUBULAR?, AMPOULE?, AMPULE?, CHAMBER?, SLEEVE?, RECEPTACLE?, CONTAINER?, BOTTLE, SEAL+, PLUG+, STOP+, CAP+, LID and similar terms		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4132186 A (MANSKE ET AL.) 2 January 1979 (See Whole Document)	1-17
X	WO 2005/ 003705 A1 (DIP) 13 January 2005 (See Whole Document)	1-8, 10
X	US 4313452 A (MELLARD) 2 February 1982 (See Whole Document)	1, 2, 13
X	FR 2144620 A (PELLET) 16 February 1973 (See Whole Document)	1,2,4
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C <input checked="" type="checkbox"/> See patent family annex		
<p>* Special categories of cited documents:</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier application or patent but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&" document member of the same patent family</p>		
Date of the actual completion of the international search 19 February 2007		Date of mailing of the international search report 26 FEB 2007
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustalia.gov.au Facsimile No. (02) 6285 3929		Authorized officer A.SEN Telephone No : (02) 6283 2158

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2006/001912

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR 2665957 A1 (LOUSTAUNAU) 21 February 1992. (See Whole Document)	1-4
X	US 6302054 (MAYER III) 16 October 2001 (See Whole Document)	1-4

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/AU2006/001912

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member			
US	4132186	US	4132186 A		
WO	2005003705	AU	2003227145 A1	CA	2522996 A1
		EP	1625369 A1	MX	PA05011426 A
US	4313452	CA	1122100 A1	US	4313452 A
FR	2144620	FR	2144620 A1	FR	2144620 B1
FR	2665957	AU	79072 / 91 A	FR	2662798 A1
		FR	2664052 A1	FR	2665957 A1
		WO	9119174 A1	FR	2662798 B1
US	6302054	US	6302054 B1	FR	2665957 B1

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX